U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Spermophilus washingtoni*

COMMON NAME: Washington ground squirrel

LEAD REGION: 1

INFORMATION CURRENT AS OF: October 11, 2005

STATUS/ACTION:

___ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

___ New candidate

_x_ Continuing candidate

___ Non-petitioned

_x_ Petitioned - Date petition received: March 20, 2000 (second petition)

_ 90-day positive - FR date:

_ 12-month warranted but precluded - FR date:

_n_ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? Yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations, and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov/).

___ Listing priority change

Former LP: _____

New LP: _______

Date when the species first became a Candidate (as currently defined): October 25, 1999

___ Candidate removal: Former LP: ___

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
___ F – Range is no longer a U.S. territory.
___ I – Insufficient information exists on biological vulnerability and threats to support listing.
___ M – Taxon mistakenly included in past notice of review.
___ N – Taxon does not meet the Act's definition of "species."
___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Mammal (Sciuridae)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Oregon (Gilliam, Morrow, and Umatilla Counties) and Washington (Adams, Columbia, Douglas, Franklin, Garfield, Grant, Lincoln, Spokane, Walla Walla, and Whitman Counties)

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Oregon (Gilliam, Morrow, and Umatilla Counties) and Washington (Adams, Douglas, Franklin, Grant, Lincoln, and Walla Walla Counties)

LAND OWNERSHIP
Betts (1990) classified land ownership for 87 known colonies in Oregon and Washington. Overall, 59 percent were on private, 17 percent government (State or Federal), and 24 percent unknown land. In Oregon, ownership for 67 percent was private, 14 percent government, and 19 percent unknown. Washington ownership was 52 percent private, 21 percent government, and 27 percent unknown land. Betts (1999) revisited these sites in 1998, finding nine occupied sites in Oregon and 37 in Washington. Of the Oregon sites visited in 1998, ownership for 11 percent was private, 78 percent government, and 11 percent unknown. Land ownership for the 1998 Washington sites was not specified, but the three vacated sites from Badger Mountain were on private land. Bett's surveys illustrate a historic decline in squirrel distribution, particularly on private land.

Most of Oregon's current known sites are on the United States Navy (Navy)'s Boardman Naval Weapons Systems Training Facility (BNWSTF), and the adjacent Nature Conservancy (Conservancy)-managed Boardman Conservation Area (BCA). Additionally, there are two locations on the Boeing tract (private land adjacent and west of the BNWSTF), one on the Conservancy's Lindsay Prairie property, a few detections on the Bureau of Land Management (BLM)'s Horn Butte property, and several scattered sites on other private property (Betts 1990, Betts 1999, R. Morgan, ODFW, pers. comm., 2005). In summary, roughly 64 percent of known Oregon sites are located on Federal land (BNWSTF and Horn Butte), 35 percent are on protected private land, and one percent is on other private lands.

In Washington, most sites documented before 2003 were on the State-owned Seep (aka Seeps)

Lakes Wildlife Management Area (SLWMA), the BLM's Wenatchee Resource Area, and the United States Fish and Wildlife Service (Service)'s Columbia National Wildlife Refuge (CNWR). The Badger Mountain sites located in Betts' 1990 survey were located on private land. Most of the currently occupied Washington locations are in Grant, Adams, and Douglas counties, but there are also isolated, scattered sites in Lincoln, Franklin, and Walla Walla Counties (G. Wiles, Washington Department of Fish and Wildlife (WDFW), pers. comm., 2005).

In 2004 the WDFW visited 302 of 535 potential sites recorded in their state heritage program database. Of the 302 sites surveyed, 49 percent were on private land (16 percent Conservancy and 33 percent other private ownership). 47 percent were located on government land (34 percent Federal versus 13 percent State) while four percent of the locations were on lands with unknown ownership (R. Finger, WDFW, pers. comm., 2004).

Together, the Boeing tract (including the BCA) and BNWSTF support most currently known Oregon colonies and roughly 50 percent of all known colonies within the species' range. This may be a conservative estimate for two reasons. First, the BNWSTF has not been surveyed according to the protocol established by Morgan and Nugent (1999), and there are likely more sites on this property. Secondly, there are likely multiple detections of the same colony in the BLM and WDFW surveys as there was in the ODFW survey (Morgan and Nugent 1999). Therefore, Washington detections and Oregon colonies are not necessarily a one-to-one ratio.

Alternatively, acreage of high quality potential habitat in areas where colonies are known to occur is a helpful indicator of Washington ground squirrel distribution. This may be an equally appropriate method for long-term monitoring since this species is threatened primarily by the historic and current loss and modification of its habitat. In Oregon land ownership of known squirrel habitat includes approximately 19,195 hectares (ha) (47,432 acres (ac)) on the BNWSTF (including roughly 1,922 ha or 4,750 ac of Conservancy-managed Research Natural Areas), 2,209 ha (5,459 ac) of Horn Butte property, 156 ha (386 ac) at Lindsay Prairie, 9,146 ha (22,600 ac) on the BCA, and an undetermined amount for the few known sites on private land (ODFW 1999). While the entire BNWSTF and BCA are not occupied, the distribution of detections fluctuates, covering large portions of the properties at various densities. There are fewer known sites at Horn Butte, but this area is likely important due to its habitat condition and close proximity to (two miles west of) the BNWSTF and BCA (ODFW 1999). In Washington, the SLWMA covers 1,836 ha (4,537 ac), and the CNWR covers approximately 9,308 ha (23,000 ac). The amount of suitable habitat on these properties and at other occupied Washington ground squirrel sites is unknown.

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BIOLOGICAL INFORMATION

Taxonomy

Washington ground squirrels belong to the family Sciuridae (squirrels, chipmunks, and marmots), subfamily Sciurinae, tribe Marmotini, subtribe Spermophilina, genus *Spermophilus* (Holarctic ground squirrels), and subgenus *Spermophilus*. The Sciuridae family has 20 congeners in western North America, nine of which occur in Oregon and Washington (Verts and Carraway 1998; Greene 1999). Washington ground squirrels are one of five North American small-eared squirrels (Harrison et al. 2003; Yensen and Sherman 2003). They are not considered to be closely related to other *Spermophilus* species (Quade 1994). The closest taxonomic relatives include Idaho (*S. brunneus brunneus* and *S. b. endemicus*) and Townsend's ground squirrels (*S. townsendii*) (Nadler 1966; Harrison et al. 2003; Klein 2005),

Washington ground squirrels were initially known as *S.* [*Citellus*] *townsendii* (Bailey 1936; Betts 1990). Their identification was clarified by Howell (1938) when he described the Washington ground squirrel as a separate species with two subspecies, *S. washingtoni washingtoni* and *S. w. loringi*. This determination was based on differences in cranial and body length measurements (Howell 1938; Hill 1978). Dalquest (1948) indicated that specimens collected in the *S. w. loringi* range were as large as specimens collected in the *S. w. washingtoni* range, suggesting they were synonymous (Betts 1990). Phenetic and karyotypic data later confirmed that this species is monotypic (Hill 1978). We have carefully reviewed the available taxonomic information to reach the conclusion that this is a valid taxon. However, it is important to note that Hill (1978) only sampled specimens immediately north and south of the Snake River within the former *S. w. washingtoni* range, but was not able to locate and analyze any live or museum specimens in the former *S. w. loringi* range. The status of *S. w. loringi* may merit further evaluation (Hafner et al. 1998). It would also be beneficial to compare samples taken from these locations with specimens collected in Oregon.

<u>Species Description</u>

Washington ground squirrels are one of the smallest members of the subgenus *Spermophilus*. They are distinguished from other Washington and Oregon ground squirrels by their relatively smaller size, light eye ring, small ear pinnae, short (one to two inch (in)) tail, and white speckled dorsum (Carlson et al. 1980, Yensen and Sherman 2003). They range from 185 to 245 millimeters (7.3 to 9.6 in) in total length and their weight fluctuates throughout the season as a function of body fat content (Rickart and Yensen 1991). In the subgenus *Spermophilus*, only the Columbian ground squirrel (*S. columbianus*) and Belding's ground squirrel (*S. beldingi*) are sympatric with Washington ground squirrels (Rickart and Yensen 1991).

The Washington ground squirrel is diurnal, semi-fossorial, and spends much of its time underground. Adults emerge from hibernation between January and early March, depending on elevation and microhabitat conditions (Sherman 2000). At high elevations, emergence and breeding occur as much as a month later than at lower elevations (Rickart and Yensen 1991). Males generally emerge before females (Bailey 1936; Verts and Carraway 1998). However, Sherman (2000) observed the following order of emergence: adult males, adult females, yearling females, followed by yearling males. Their active time is spent in reproduction and fattening for their seven to eight month dormancy. Adults return to their burrows by late May to early June, and juveniles return about a month later (Carlson et al. 1980; Verts and Carraway 1998).

Estivation is thought to transition directly into hibernation (ODFW 1999; Sherman 2005). The average lifespan for this species is unknown. Although most Washington ground squirrels live less than five years, Sherman (2005) documented a female that was at least seven years old in 2005.

Washington ground squirrels produce only one litter of young per year due to their limited period of activity and reproduction. Sherman (2000 and 2005) noted that females were sexually receptive on only one afternoon per season, usually within a few days of emergence from hibernation, and copulation occurred underground. Sherman (2005) observed that females mate with one male, whereas males mate with all females residing in their territory. However, confirmation of this observation awaits analysis of DNA samples collected (Sherman 2005). Uterine litter sizes range between five and 11 with an average of eight (Scheffer 1941). Carlson et al. (1980) reported an average litter size of 5. Sherman (2000) observed that one-year old and older females mated, whereas males were not sexually mature until age 2. Sherman (1999) indicated that Washington ground squirrels gave birth during the last two weeks in February near Othello, Washington. The first litter of pups was seen above ground in mid-March. In Oregon, Carlson et al. (1980) reported the first litter of pups in early April, but litters have also been observed in early to middle March (V. Marr, pers. comm. 2003). Sherman (1999) estimated that gestation and lactation required approximately 49-50 days.

Little is known about Washington ground squirrel behavior. Sherman (2000) indicated they are quite different from closely-related Idaho ground squirrels (*S. brunneus*). Washington ground squirrels can be solitary (Yensen and Sherman 2003) or exist in colonies up to at least 250 individuals (Bailey 1936; Csuti et al. 1997). Sherman (2005) hypothesizes that group-living and social cooperation in this species may be adaptations to predation pressure and food distribution and abundance. His 2005 observations at Washington sites revealed that females are exceptionally social. They often formed coalitions or groups with up to three other females, within their semi-isolated communities. Partners exhibited a variety of cooperative behavior, some of which have not been described in any other ground-dwelling sciurids. Some of the cooperative behaviors included joint nest burrow excavation and nest building, cooperative predator chasing, sharing the same burrow overnight, and raising pups from the same burrow. Genetic relationships among females that formed coalitions are unknown, but they were likely close kin (Sherman 2005).

Males defend territories of 370 to 930 square meters (m) (4,000 to 10,000 square feet (ft)) with burrows of up to six females (Sherman 2000). Sherman (2005) observed that males maintain their territories throughout their females' active seasons (during gestation, lactation, and after pups emerged). Delavan (2004) reported preliminary mean home range sizes in Oregon for adult and yearling females (4,500 square m or 48,438 square ft) and males (21,570 square m or 232,177 square ft) using the Minimum Convex Polygon method. Females appear to have smaller home range sizes, as well as a smaller array of home range sizes than males. Finalized details will be available after the second year of data is analyzed.

Males appear to be more mobile and/or dispersive than females (Greene 1999; Sherman 2005), and dispersal may occur during post-weaning and post-mating (Sherman 2005). Klein (2005) determined the dispersal status for 102 juvenile males in Oregon. The average dispersal probability was 0.72, and probability of dispersal did not vary significantly by site or year. Dispersal distances ranged from 40 to 3521 m (131 to 11,551 ft), with a median of 880 m (2,887 ft). Timing of dispersal in 2003 occurred significantly earlier than in 2002, and may be attributed to weather patterns (Klein 2005). All post-dispersal sites were located in sagebrush and annual grass habitat. While squirrels appeared to avoid low-shrub and perennial grass habitat, these vegetation types comprised only 16.2 percent of available habitat. Squirrels did not select sites on soil series, or for avoidance of slope, aspect, or recently burned areas (56 percent of available habitat). Squirrels did select sites with silt-loam texture soils, and were found closer to primitive roads and historically occupied sites that expected. Primitive roads were not dispersal barriers but land in agricultural production likely altered dispersal patterns (Klein 2005).

In Washington, Sherman (2005) documented two known juvenile male dispersal movements from trap data: 1,300 m (4,265 ft) in 25 days and 300 to 400 m (984 to 1,312 ft) in 26 days. No evidence of juvenile female dispersal was documented in 2005. While Klein (2005) only radio-collared one juvenile female, making it unlikely to detect juvenile female dispersal, Sherman (2005) and Carlson et al. (1980) had an equal opportunity to observe juvenile male and female dispersal using trap data. Sherman (2005) noted that squirrels typically inhabit bottoms of coulees where sandy soil is deep enough for burrow excavation. Steep basaltic coulee walls form natural corridors and barriers, making linear dispersal (up and down the coulee) possible but lateral dispersal (up and over the sides) difficult for this species.

Klein (2005) noted that dispersal benefits this species by increasing access to mates, maximizing outbreeding, and reducing inbreeding. Dispersal rates and population density were negatively correlated; suggesting dispersal is intrinsic and served a different purpose than to reduce natal competition. Dispersers appear to have a higher estimated probability of survival to hibernation than non-dispersers (41 versus 26 percent), which has not previously been observed in this genus. Dispersers were more vulnerable to predation by raptors and non-dispersers were more vulnerable to predation by badgers. Most mortality occurred after dispersal, suggesting the settling period may be more costly than actual dispersal (Klein 2005). Dispersers may have greater fitness than non-dispersers; however it is not known how many dispersers versus non-dispersers survived through estivation.

Habitat

Washington ground squirrels are found within the shrub-steppe habitat of the Columbia Basin ecosystem (Verts and Carraway 1998; Dobkin and Sauder 2004). Within this ecosystem, they are found in a variety of microhabitats (Quade 1994). While historically associated primarily with sagebrush (*Artemisia* sp.) and bluebunch wheatgrass macrohabitats, much of the native vegetation has been removed and/or altered such that cheatgrass and rabbitbrush (*Chrysothamnus* sp.) have replaced most of the original flora in areas of nonagricultural land (Verts and Carraway 1998).

Betts (1990) determined that the Washington ground squirrel occupied areas with a greater annual and total grass and forb cover than adjacent, unoccupied areas. He also found greater occupation in areas with deeper soil, weaker soil, and soils with less clay which was attributed to the need for burrow excavation (Betts 1990). There was a slightly greater, but statistically significant increase in the clay content of unoccupied sites (Betts 1990). Yensen and Sherman (2003) indicate the importance of sandy soils.

Greene (1999) compared occupied to unoccupied shrub and grassland habitats to determine the factors most commonly associated with habitats used by Washington ground squirrels. Soil type may be the most important habitat feature. Greene (1999) determined that the species selects soils with high silt content and lower clay content, such as Warden soils that are found scattered throughout much of their range. Warden soils not only have a high silt content, but they are also very deep (U.S. Department of Agriculture 1983), allowing for deeper burrows that will maintain their structure compared to sandy or shallow soils. Warden soils occur east and south of the Columbia River. While they appear to prefer Warden soils, they can also be found in other soil types including Sagehill, Royal, Quincy, Koehler, Burbank, and Ellum soils (Greene 1999; Morgan and Nugent 1999; Marr 2001).

Greene (1999) also found that Washington ground squirrels occurred at sites with higher vegetative cover. Transect surveys and capture-recapture data indicated highest densities in sagebrush, followed by grassland habitat. Recruitment was highest in sagebrush, followed by bunchgrass then low-shrub habitat. Mean weight for adults and juveniles was highest in bunchgrass, followed by sagebrush, and low-shrub habitats (Greene 1999). Sagebrush habitat may maintain ground squirrel populations because it supports a more stable food source, especially during drought periods (Van Horne et al. 1998b; Greene 1999). Shade may increase succulence of other forage while maintaining lower soil temperatures which could decrease evaporative water loss (Bintz 1984; Van Horne et al.1997; Greene 1999). High daytime temperatures can restrict squirrels to foraging during cooler times of the day. Squirrels with accessible shade near food sources could remain active longer, maximizing foraging time (Carlson et al. 1980). Sharpe and Van Horne (1999) determined that suitable above ground microclimates existed throughout most of the season in sagebrush habitat for Piute ground squirrels (*S. mollis*). Availability of microhabitats could be important for ground squirrels, especially in hotter portions of their active season and in drought or hotter than normal years (Sharpe and Van Horne 1999).

Marr (2001) visited Greene's sites after a 1998 fire burned 9,700 ha (23,969 ac) of the BNWSTF. Most colonies were located in Warden and Royal series soils. Colonies located in Warden soils, had lower vacation rates in burned versus unburned areas. For other soil types, Marr found lower vacation rates in sites that were not burned. This appears consistent with prior investigations (Betts 1990; Quade 1994; Greene 1999) that suggest recovery of populations from drought induced lows of the 1980's began earlier, was stronger, and was less variable in areas with Warden soils compared to other soils (Marr 2001). It is not clear if this is attributed to the soil type, vegetation associated with this soil series, or because Warden soils are mostly located on the south end of the BNWSTF where there is higher annual precipitation that helps sustain vegetation later into the season. Stony layers of caliche, which can inhibit burrow excavation, tend to be deeper in Warden soils than other types. Furthermore, vegetation in Sagehill, Quincy, Koehler soils cures earlier making it likely that reproductive curtailment and lower rates of persistence are more pronounced in those areas than warden soils (Marr 2001).

There have been no systematic investigations (only anecdotal observations) of Washington ground squirrel burrows (Quade 1994). Washington ground squirrel burrows are usually small, inconspicuous, and are often located under obstructions. Soil from burrows is typically scattered without forming mounds (Yensen and Sherman 2003). Greene (1999) noted that vegetation approximately within a 30-centimeter (11.8-in) radius around entrances was typically removed or clipped. Bailey (1936) described burrows as simple, little branched, descending 1.2 to 1.5 m (3.9 to 4.9 ft) from a single entrance before straightening for a few feet and entering a nest cavity (Quade 1994). Howell (1938) described a 7.3-m (24-ft) burrow without branches lacking a nest cavity that reached a max depth of 1.7 m (5.6 ft) (Quade1994). Scheffer (1941) observed that old pocket gopher and abandoned badger digs are used by Washington ground squirrels, so it is likely that Washington ground squirrel activities take place in more than one type of burrow (Quade 1994). Idaho and Townsend's ground squirrels construct at least two types of burrows (Yensen et al. 1991; Quade 1994), and morphology of Wyoming (*S. elegans*) and Townsend's ground squirrels differ with soil structure (Quade 1994). It seems reasonable that this may be true for Washington ground squirrels. Sherman (2005) noted that the number of active burrows do not accurately reflect local population densities.

<u>Diet</u>

Washington ground squirrels eat a broad range of succulent forb and grass stems, buds, leaves, flowers, roots, bulbs, and seeds (Greene 1999). They shift to the seeds of grasses and forbs as they become available later in the season (Quade 1994). They also eat limited quantities of insects (Carlson et al. 1980), and crops such as cabbage, peas, corn, oats, wheat, rye, barley, and alfalfa are also consumed when available (Bailey 1936; Howell 1938). Diversity in their diets help meet their dietary needs for reproduction (especially protein) and survival during estivation and hibernation (especially fatty seeds) (Tarifa and Yensen 2004; Sherman 2005).

Tarifa and Yensen (2004) are conducting a multiple-year study of Washington ground squirrel diets at four sites in Washington by analyzing fecal pellets. Available vegetation at two sites (Crab Creek and Warden Lake near Othello) contained high percentages of nonnative plants and two other sites (Jameson Lake and Badger Mountain) had high percentages of native vegetation. Fecal pellets were collected during the middle, early-late, and late season in 2003. Diets were diverse and squirrels ate 27 to 37 species per site (35 to 61 percent of total species available). However, only one to six species comprised greater than five percent of their diet at any site in any season. At all sites more grasses than forbs were consumed during the middle of their active season. Grasses remained more important in the early-late and late seasons at sites with more nonnative vegetation, while forbs were more important at sites with greater native vegetation during the early-late and late season.

Native plants that appear important to Washington ground squirrels include the following species: bluebunch wheatgrass (*Agropyron spicatum*), needle-and-threadgrass (*Heterostipa comata*), Sandberg bluegrass (*Poa secunda*), saltgrass (*Distichlis spicata*), Idaho fescue (*Festuca idahoensis*), squirreltail (*Sitanion hystrix*), needle grasses (*Stipa* sp.), lupine (*Lupinus* sp.), wild onion (*Allium* sp.), fiddleneck (*Amsinckia tessellata*), milkvetch (*Astragalus* sp.), Indian paintbrush (*Castelleja thompsoni*), linear-leaved collomia (*Collomia linearis*), hawksbeard (*Crepis* sp.), larkspur (*Delphinium* sp.), tansymustard (*Descurainia californica*), spring draba

(*Draba verna*), western stickseed (*Lappula redowskii*), bitterroot (*Lewisia reduviva*), lomatium (*Lomatium* sp.), white-stemmed mentzelia (*Mentzelia albicaulis*), penstemon (*Penstemon* sp.), longleaf phlox (*Phlox longifolia*), Indian wheat or plantain (*Plantago patagonica*), death camas (*Zygadenus paniculatus*), and greasewood (*Sarcobatus vermiculatus*). These species either comprise five percent or more of their diet, or were identified as important for other, non-dietary reasons.

In 2002 and 2003, species abundance in diet was not correlated with availability, indicating that Washington ground squirrels are selective feeders. 2002 results differed from 2003, indicating variability by year and not just by site (Tarifa and Yensen 2003, 2004). Bluegrass is especially important in their diets (Tarifa and Yensen 2003, 2004). Additionally, bluebunch wheatgrass, stipa, lupine, crepis, and squirreltail stems, seed heads, flowers, and seed pods were found near burrow entrances and rock piles at Jameson Lake in the late season with bite marks. While they are not necessarily highly abundant in their diet, it indicates they are still important to squirrels (Tarifa and Yensen 2004).

Analysis of stomach contents have also documented the following additional taxa in their diets: filaree (*Erodium* sp.), globemallow (*Sphaeralcea* sp.), slender wheatgrass (*Agropyron pauciflorum*), Indian ricegrass (*Oryzopsis hymenoides*), and tumbleweed (*Salsola collina*) (Quade 1994). Cheatgrass (*Bromus tectorum*) is also consumed, but its nutritional value and persistence through drought is unknown (Carlson et al. 1980; Tarifa and Yensen 2003, 2004).

Significance

Washington ground squirrels, like other ground squirrels, are important components of ecological ecosystems. They have inhabited the Columbia Basin for at least 13,000 years (Spencer 1989; Marr 2001). Washington ground squirrels are a prey base for predator food chains, reduce soil compaction, loosen and aerate soils, and increase the rate of water infiltration into soil. Additionally, they increase soil fertility, bring nutrients from deep soil layers to the surface, increase plant productivity, increase plant diversity by bringing buried seeds near the surface, and increase diversity of microhabitats (Vander Haegen et al. 2001; Yensen and Sherman 2003). Predation of Washington ground squirrels by badgers creates burrows that are reused by many species including snakes, lizards, ground squirrels, insects, and burrowing owls (Greene 1999).

Historical Range/Distribution

The Washington ground squirrel is endemic to the Columbia Plateau, south of the Columbia River and east of the John Day River (Bailey 1936; Howell 1938; Betts 1990; Csuti et al.1997; Verts and Carraway 1998). Generally, there is little information regarding ground squirrel abundance prior to European settlement. Their distribution may have been contiguous (Verts and Carraway 1998) or patchy, with subpopulations acting as sources and sinks. Their distribution was likely driven by foraging (Vander Haegen et al. 2001) and soils needs.

Although the species is associated with sagebrush-grasslands of the Columbia Plateau (Betts 1990; Verts and Carraway 1998), studies indicate that silt loam soils, especially those classified as Warden soils, are of particular importance (Rickart and Yensen 1991; Greene 1999). It is generally thought that squirrels prefer Warden soils because of the relative ease of digging and maintaining burrow systems rather than in other soils with high clay content or high sand content (Greene 1999). The burrowing mammal seldom constructs burrows in areas of heavily disturbed soils, such as areas affected by activities including plowing, discing, and crop production (Betts 1990, 1999; Greene 1999).

Current Range/Distribution

Washington ground squirrels occur east of the Columbia River primarily in two metapopulations (or clusters of isolated or potentially interconnected sites) in the State of Washington, and one metapopulation south of the Columbia River in the State of Oregon (Betts 1990, 1999). The three areas are highly disjunct, separated by more than 50 kilometers (km) (30 miles (mi)) of unoccupied land (Betts 1990).

The most northwesterly metapopulation in Washington, Badger Mountain, is the smallest and most isolated of the three locations. This area consisted of nine historic detections prior to 1989 (Betts 1990). When surveyed in 1987 to 1989, only four extant colonies were found, all of which were small and classified as highly vulnerable to extinction (Betts 1990). When resurveyed in 1998, squirrels were verified at only one of the four previously extant locations. Four additional colonies were reported north of the Badger Mountain population, but details about these sites were not provided (Betts 1999). Recent surveys on the BLM's Wenatchee Resource Area in Washington reported 83 Washington ground squirrel detections, 33 of which were made in Douglas County (Musser et al. 2002). Four additional sites were incidentally located on private land. It is also not clear whether a single detection represents a single colony, or whether some colonies were large enough to intersect transect lines more than once and therefore had multiple detections for one colony.

The Columbia Basin metapopulation in southeast Washington, as described by Betts (1990), has not been exhaustively surveyed, but was reported to have 47 colonies in 1989 (Betts 1990) and 37 when resurveyed in 1998 (Betts 1999). Colonies appear to be scattered in this area with a core area of occurrence at the center of the population range (Betts 1999). Recent, site-specific studies have located more colonies within the range of the Columbian Basin population in the SLWMA and the CNWR near Othello, Washington (Sherman 1999, 2000). Sherman (1999, 2000) observed 23 sites with squirrels in 1999 and again observed squirrels at each site in 2000. Four were located on the CNWR and 19 were on the SLWMA. Only 19 of the 23 sites were active in 2001 showing a 17 percent decrease in the active population from 1999 to 2001 (Sherman 2001). Musser et al. (2002) had 50 detections on BLM land in Grant County during a Washington ground squirrel survey.

In 2004, the WDFW visited 302 of 535 historic sites throughout their Washington range. They found activity at 207 of 254 (81 percent) known sites that had been surveyed and recorded as active within the past there years prior to this survey. Information was not provided regarding the other 48 sites surveyed. While there has recently been an overall increase in number of detections, it is notable that many of these detections are located in fragmented clusters. It is not known or specified whether a single detection or a cluster constitutes one colony. For example, WDFW noted that four detections at Foster Coulee were vacant in 2004. These detections were all within four ha (10 ac), which could constitute a subpopulation. Some clusters are connected by what appears to be suitable habitat, while other clusters are fragmented, primarily by agricultural development since the completion of the Columbia Basin Irrigation Project (R. Finger, pers. comm., 2004).

The Oregon metapopulation is centered almost entirely on the BNWSTF and the adjacent BCA (which is part of the Boeing tract). The Boeing tract covers approximately 34,555 ha (95,000 ac). R.D. Offutt Company-Northwest (Offutt Company) and Bos Family Oregon Farms (collectively referred to as Threemile Canyon Farms) purchased approximately 36,705 ha (90,700 ac) from the State of Oregon in November 2002. Threemile Canyon Farms leases 1,093 ha (2,700 ac) to The Boeing Company (Boeing Radar Range), and put 9,146 ha (22,600 ac) of its property into a permanent Oregon Department of Fish and Wildlife (ODFW) Conservation Easement (which entails most of the BCA). The Conservancy manages the BCA under a 40-year lease from the Threemile Canyon Farms. Portland General Electric (PGE) owns and/or leases 1,740 ha (4,300 ac) of the Boeing tract and has dedicated 356 ha (880 ac) for conservation (PGE Conservation Area) (David Evans and Associates 2004).

Historic and new sites were monitored on the BNWSTF in 1997, 2000, 2001, 2002, and 2003. In 2003, there were 149 sites: 118 small, 25 medium, and five large (Marr 2003). Additional sites were recently located in the northern portion of the BNWSTF (V. Marr, pers. comm., 2005). A thorough survey of the BNWSTF has not been conducted and would be valuable. Marr (2003) did not provide an exact definition for small, medium, and large colonies on the BNWSTF. However, they are likely similar to the sizes used when he surveyed the BCA in 2004 (small: zero to 2,500 square m (26,610 square ft), medium: 2,500 to 10,000 square m (26,610 to 107,639 square ft), and large: greater than 10,000 square m (107,639 square ft) (Marr 2004).

Surveys conducted or funded by ODFW, PGE, Threemile Canyon Farms, and the Conservancy from 1999 to 2001 detected 123 Washington ground squirrel locations on the Boeing tract. Marr (2004) revisited 90 of 92 known colonies (121 of 123 detections) on the Boeing tract. He reported 66 (73 percent) occupied sites in 2004, and incidentally discovered 16 new sites. The PGE Conservation Area site and Boeing Radar Range sites were not revisited in 2004 (Marr 2004). The few known Washington ground squirrel sites apart from the Boeing tract and BNWSTF in Oregon include one site on Conservancy property (Lindsay Prairie), one site south of Arlington, a few detections on BLM-managed Horn Butte, and limited sites on private property (Betts 1990, 1999; R. Morgan, pers. comm. 2004).

<u>Population Estimate/Status</u>

Mark-recapture studies have addressed sex-ratios, age structure, and Washington ground squirrel abundance in Oregon (Carlson et al. 1980; Quade 1994; Greene 1999; Klein 2005) and Washington (Sherman 1999, 2000, 2001, 2005). For example, Klein (2005) estimated population densities at four of what are considered the largest and most dense sites in Oregon. Densities ranged from 11 to 82 squirrels per ha (roughly five to 33 per ac) in April 2002 to 20 to 90 per ha (eight to 36 per ac) in April 2003. The average ratio of juveniles to adults both years was 4:1. Ratios and abundance vary enormously between colony sites and seasons, but serve as a snapshot in time for the particular sites studied.

There is no good calculation of overall population size (trend or size of colonies or individuals) due to an overall poor understanding of their population dynamics (ODFW 1999). Populations appear to fluctuate widely at a local scale. However mark-recapture information, combined with survey efforts by the Conservancy, PGE, ODFW, WDFW, BLM, and others, provide useful information on the incidence and distribution of the species. Long-term monitoring of populations will be necessary to better understand population dynamics at a local scale. On a larger scale, it will be essential to monitor the amount of available and connected occupied (versus unoccupied) habitat as this may be the best indicator for the long-term persistence of this species. While an increase in known sites indicates a larger distribution and incidence for this species, this increase is partly due to an increased survey effort and because this species may be at a high peak of a population cycle (R. Morgan, pers. comm., 2005). New locations have, for the most part, been constrained to the same isolated and disjunct areas described by Betts (1990; 1999).

DISTINCT POPULATION SEGMENT (DPS)

To date, no analysis of potential distinct population segments have been done. Studies indicate that Washington ground squirrels are monotypic (Hill 1978). However, Hafner et al. (1998) indicated that the status of *S. w. loringi* may merit further evaluation. An upcoming study will address the population dynamics of squirrels on the SLWMA, as well as a genetic analysis of selected sites in Washington (R. Hill, Service, pers. comm. 2005). This would be an ideal opportunity to assess the status of *S. w. loringi*, and to determine whether any of the three metapopulations are discrete. If any are determined to be discrete, a determination of significance should be undertaken as well, and distinct population segments could be delineated, as appropriate, at that time.

THREATS

A. Destruction, modification, or curtailment of its habitat or range.

Numerous sources cite a dramatic (51 to 85 percent) loss of historic Washington ground squirrel habitat throughout the Columbia Basin (Betts 1990, 1999; Hafner et al. 1998; ODFW 1999; Kagan et al. 2000; Wisdom et al. 2000; Knick et al. 2003; Dobkin and Sauder 2004; Quinn 2004; Tarifa and Yensen 2004). The discrepancy in estimated habitat loss occurs partly because some sources estimated the amount of destroyed habitat while others also included the percent of habitat that has been modified. In the Umatilla Basin (which is roughly equal to the historic distribution of Washington ground squirrels in Oregon), there has been an 86 percent decrease of historic big sagebrush and 44 percent decrease of bluebunch wheatgrass habitat. In Washington, only 40 to 50 percent of historic shrub-steppe habitat remains, and public lands comprise a small portion of Washington's remaining shrub-steppe habitat (Dobler 1996; Vander Haegen et al. 2001). Overall, approximately two-thirds of Washington ground squirrel's total former 47,800-square km (or 11,811,637-ac) range has been converted to agriculture (Tarifa and Yensen 2004).

Most habitat destruction and range curtailment is attributed to agricultural (i.e. crop circle) development (Carlson et al. 1980; Betts 1990, 1999; Quade 1994; Dobler 1996; Vander Haegen et al. 2001). Historic agricultural development occurred primarily in areas with arable, deep soil. Consequently, there has been a disproportionate loss of these soil communities, leaving a greater proportion of shallow soil shrub-steppe habitats (Vander Haegen et al. 2001). Since ground squirrels depend on deep soil (Betts 1990, 1999; Greene 1999), this has reduced much of their habitat. Vander Haegen et al. (2001) warned that conversion of deep soil shrub-steppe communities to irrigated agriculture will likely continue in the foreseeable future, "making this [shrub-steppe habitat] one of our most endangered arid land communities." Agriculture appears to be a one of the threats for some of the Washington sites (in the Potholes area), but is not currently an issue for sites in the SLWMA and CNWR (R. Hill, pers. comm., 2005).

Betts (1990, 1999) documented the curtailment in the range of the Washington ground squirrel. His surveys on historic and documented occurrences focused on the perimeter of the range with the intent of evaluating reductions in numbers of colonies and the size of the current range. Although Betts' surveys do not provide an exhaustive review of all potential squirrel locations or numbers of individuals, they do provide a good estimate of the distribution and decline of Washington ground squirrels in Oregon and Washington. Betts found that the species had disappeared from 73.8 percent of known historic sites in Washington and 76.9 percent of known historic sites in Oregon.

The historic range of the species, distributed over much of the shrub-steppe habitat of southeastern Washington and northeastern Oregon, has been modified and reduced to three disjunct metapopulations (Betts 1990, 1999; Quade 1994; ODFW 1999; Vickerman et al. 2000). The smallest area is the Badger Mountain metapopulation. It consisted of nine historic locations prior to 1989 (Betts 1990). When surveyed in 1987 to 1989, only four extant colonies were found, all of which were small in size and classified at a high vulnerability to extinction (Betts 1990). When surveyed again in 1998, squirrels were verified at only one of the four previously extant locations (Betts 1999). At two sites, one colony had been exterminated by the landowner, and the habitat had been removed for a house at the other (Betts 1999). Four additional colonies have been reported north of the Badger Mountain metapopulation (Betts 1999) and the BLM documented additional sites in Douglas County (Musser et al. 2002).

The Columbia Basin metapopulation is the most widely distributed and least well surveyed area. However, it is likely the most sparsely populated area within the species current range due to natural habitat conditions and the modification of suitable habitat for agriculture. Historically, approximately 56 sites occurred in this area (Betts 1990). Betts' (1990) surveys indicated that about 43 sites had been lost in this area, and about half since 1978. Of the approximately 47 historic and new confirmed sites in this area in 1987 to 1989, Washington ground squirrels were still evident at 37 (78 percent) in 1998 (Betts 1999). Most of these losses have resulted in further range curtailment, occurring primarily at the northern and southern boundaries of the range of the Columbia Basin metapopulation. More recent surveys located new colonies, but have also documented subsequent vacations, on the SLWMA and the CNWR. Only 19 of 23 sites located in 1999 were active in 2001 showing a 17 percent decrease in the active population from 1999 to 2001 (Sherman 1999; 2000; 2001). Musser et al. (2002) reported 50 new detections in Grant County on BLM land and four on nearby private property.

While recent surveys have documented additional Washington locations, a large scale WDFW survey effort documented further reduction of historic colonies. The WDFW visited 302 of 535 historic locations in Washington (including sites documented by Betts, Sherman, and likely BLM). 207 of 254 known sites had activity, indicating a 19 percent rate of site vacation. Information was not provided regarding the other 48 sites surveyed, meaning vacation rates for 302 sites could be as high as 32 percent but likely fall within 19 and 32 percent. Since 233 historic sites were not surveyed, this rate of vacation reflects only sites surveyed and not the overall known historic locations. Since they only surveyed sites with confirmed occupancy within three years prior to the survey, it is reasonable to assume the rate of vacation is likely higher for the other 233 sites that were not surveyed. Some of the sites were clustered and connected by what appears to be suitable habitat, while other clusters were fragmented, primarily by agricultural development (R. Finger, pers. comm., 2004).

Range reduction and documented habitat destruction have been greatest in Oregon within the Columbia Plateau metapopulation (Betts 1990, 1999). All but one of the 36 new and historic sites, located by Betts in 1987 to 1989, were located on or just south of the BNWSTF. Washington ground squirrels had disappeared from 20 of 26 historic locations, 12 of which were lost between 1979 and 1989 (Betts 1990). By 1999, the 36 observed colonies had been reduced to nine, a decrease of 75 percent (Betts 1999). Since Betts' surveys were conducted, Greene (1999) completed a more detailed survey of the BNWSTF, documenting 69 colonies. Marr (2003) revisited Greene's locations and found additional sites, documenting 149 total sites in 2003 (Marr 2003). While additional colonies have been reported, a number of colonies have been vacated. For example, only 115 of 188 (61.2 percent) colonies originally located in 1997, 2000, 2001, and 2002 were occupied in 2003 (Marr 2003). It is unclear whether new colonies and detections will persist in the long-term. Although additional colonies have been found, the losses in historic populations provide a quantitative measure of known declines which was likely paralleled among previously undiscovered locations. Anecdotal accounts and references support this unquantified loss in Washington ground squirrel numbers and colonies (Bailey 1936; Howell 1938; Carlson et al. 1980; Verts and Carraway 1998).

Morgan and Nugent (1999) completed the most comprehensive survey within the species' range in Oregon on about 7,824 ha (19,333 ac) on what is currently part of the BCA. They located 37 colonies from 104 detections. More recent surveys located 11 additional sites on the BCA (TNC 2001), one on the PGE Conservation Area, and one on the Boeing Radar Range (Marr 2004). No sites have been located in areas surveyed on Threemile Canyon Farms outside of the BCA (CH2M Hill 2000; David Evans and Associates 2004). The Conservancy revisited all of the 90 known colonies (or 121 detections) on the BCA in 2004. Sixty-six (73 percent) of sites were occupied in 2004, whereas 24 (27 percent) were vacant. Of the 62 known in 1999, 44 (71 percent) were still occupied while 18 (29 percent) were vacant, making a five-year prorated vacation rate of 5.8 percent per year. Of the 20 sites first identified in 2001, 16 (80 percent) were occupied while four (20 percent) were vacant, with a three-year prorated vacation rate of 6.7 percent per year. While 24 sites have become vacant since 1999, it is notable that 16 additional sites were located incidentally in 2004 (Marr 2004).

Some portions of the Threemile Canyon Farms are restricted and remain unsurveyed. However, outside of the BCA, the majority of the undeveloped portions of the Threemile Canyon Farms contain relatively small amount of potential suitable habitat. It is possible that there may be some loss of colonies from future agricultural development; however, the BCA contains all but two of the known locations on the Boeing tract (David Evans and Associates 2004). The Boeing Radar Range may contain suitable habitat and will be surveyed for Washington ground squirrels by qualified biologists prior to any ground disturbing activities (David Evans and Associates 2004). While the proposed development of Threemile Canyon Farms for agriculture is a threat to the Oregon metapopulation, the potential impact of this development has been greatly reduced since a large portion of known sites are protected on the BCA. Development for agriculture is still a potential threat for the species throughout its range.

The BNWSTF, which supports the highest known concentration of Washington ground squirrels and best available habitat (Carlson et al. 1980; Betts 1990; Quade 1994; Greene 1999), is not fully secure. Roughly 1,922 ha (4,750 ac) are designated as Research Natural Areas and managed by the Conservancy. The remaining 17,273 ha (42,682 ac) are managed by the Navy for military training, and has previously been managed for grazing allotments (Quade 1994; Greene 1999). The Navy has not allowed grazing on the site for at least two years (V. Marr, pers. comm. 2004), but this does not preclude grazing in the future. While light to moderate grazing does not appear problematic to this species (Greene 1999), more intensive grazing can reduce the amount and quality of food available for squirrels either directly or by altering the vegetative community structure.

The Navy planned to decommission the base within the year 2000, eliminating all military training and military security personnel from the site (S. Pennix, Navy, pers. comm. 2000). However, as of 2004, the Navy was still using the site for military training and had placed additional personnel on the BNWSTF, which indicates that the Navy will continue to manage the site in the foreseeable future. The Navy will continue to manage the site as it does not have the resources to extensively remove potential unexploded ordinances (UXO) or toxic materials (S. Pennix, pers. comm. 2000). Limited UXO removal occurred in 2005, but the specific methods used and potential threat of UXO removal is unknown (J. Delavan, Service, pers. comm., 2005). The Navy and Oregon Military Department (OMD) are going through the National Environmental Policy Act (NEPA) process to install two shooting ranges on the north portion of the BNWSTF where colonies are thought to be fewer. Private consultants surveyed the proposed area and located numerous detections in the proposed project area. The Navy and OMD are working with ODFW on this project since Washington ground squirrels are listed endangered under the Oregon Endangered Species Act (OESA).

In addition to habitat loss and modification from agriculture and military activities, there are an increasing number of wind power projects in Washington ground squirrel habitat. Proposed wind power sites appear to be more of a threat (are more widespread) in Oregon (R. Morgan, pers. comm., 2004), than Washington (G. Wiles, pers. comm., 2005). Wind power projects can have negatively impact squirrels by permanently removing habitat in known sites or suitable habitat adjacent to occupied sites, further fragmenting the species' distribution. The footprint of each project is relatively small (two to 16 ha or five to 40 ac), but there are numerous projects throughout the species range in Oregon and the overall impacts are not addressed cumulatively. For the past three years, ODFW has consistently dealt with one to three proposals at any given time (because some projects require OESA permits). Many projects have been permitted, but are not yet developed. Nearly all proposed project sites are in native shrub-steppe habitat (R. Morgan, pers. comm., 2005). Effects other than direct habitat loss from wind power development and operation are poorly understood and have not been studied.

In Oregon, there is a formal conservation agreement to protect this species in a large portion of its range in Oregon. The Threemile Canyon Farms Multi-Species Candidate Conservation Agreement with Assurances (Agreement) between Threemile Canyon Farms, the Conservancy, PGE, ODFW, and the Service was signed in 2004. The Agreement includes commitments from the permittees to implement a number of conservation measures intended to benefit the Washington ground squirrel and three bird species. One of the most significant conservation measures was the placement and management of 9,146 ha (22,600 ac) into a permanent state conservation easement, and another 356 ha (880 ac) of property was designated by PGE Conservation Area. Together, this protects approximately one-third of known habitat and half of known colonies in Oregon. However, this area is also the most thoroughly surveyed area, which can bias these estimates.

In Washington, there are currently no formal agreements with private landowners, or State or Federal agencies to protect the Washington ground squirrel, nor do State or Federal agencies have management plans that specifically address the needs of the species or its habitat.

Betts (1990) subjectively evaluated the vulnerability to extinction of each of the remaining known colonies based on colony size, isolation, land ownership, and threat from human activity. Approximately 29 percent of all colonies were highly vulnerable to extinction (19 percent in Oregon, 35 percent in Washington); 31 percent were moderately vulnerable (39 percent in Oregon, 25 percent in Washington); and 40 percent had low vulnerability (42 percent in Oregon, 39 percent in Washington). In many cases, Betts' predictions proved correct, and many colonies classified as vulnerable were no longer present by 1999 (Betts 1999).

B. Overutilization for commercial, recreational, scientific, or educational purposes.

Washington ground squirrels are often viewed as pests (Bailey 1936; Howell 1938; Rickart and Yensen 1991; Rulofson 1993; Askham 1994; Wisdom et al. 2000) and are subject to recreational shooting and poisoning to reduce impacts to agricultural crops (Betts 1990, 1999; Rickart and Yensen 1991; Hafner et al. 1998; ODFW 1999; Sherman 2000). Sport shooting (plinking) and poisoning can be devastating to some species when their populations are small and isolated (Yensen and Sherman 2003). Olterman and Verts (1972 *in* ODFW 1999) attributed the decline of Washington ground squirrels from 1948 to 1970 to years of control by poisoning and/or shooting, in addition to significant habitat loss. Sherman (2000) documented deaths of two individuals marked for study. One carcass of a pregnant female was found with a bullet wound in the back. The dominant male of the colony disappeared and was presumed to have been shot. These individuals represented 22 percent of the marked individuals in the colony and were the only observed Washington ground squirrel mortalities during the 2000 field season. Sherman (2005) did not observe any losses of squirrels from his study sites due to shooting in 2005.

Previous Washington ground squirrel studies have involved purposeful mortality of squirrels for scientific collection and to study diet, reproduction, and other characteristics. More recently, there is likely some incidental mortality and/or harassment from live-trapping, radio-collaring, monitoring, and behavioral studies. However, this mortality appears to be minimal, and scientists employee a variety of measures to decrease the amount of mortality due to research.

C. Disease or predation.

Little disease is known or reported to occur in Washington ground squirrel populations. More than half of the North American rodent species of conservation concern are within the zone colonized by the bacterium *Yersinia pestis* (which causes the plague) (Hafner et al. 1998). *Y. pestis* can be transmitted by fleas (Gage and Kosoy 2005). Ectoparasites (fleas, mites, etc.) are frequently observed on captured individuals but seldom appear to be problematic (Carlson et al. 1980; Sherman 1990, 2000, 2005). Carlson et al. (1980) tested three species of fleas collected from Washington ground squirrels (including *Thrassis petiolatus*, *Opisocrostis tuberculatus tuberculatus*, and *Opisocrostis washingtonensis*) for plague. All of the samples tested negative.

Several ground squirrel species are hosts to plague. The plague has been documented in Washington ground squirrels. Svihla (1939) reported plague occurrence among ground squirrels in Washington that were well within the Washington ground squirrel's range. While there was no direct evidence, Svhila reasoned that the plague caused recent extirpation of squirrel colonies in the vicinity where plague occurrence was found. Additionally, Townsend's ground squirrels were seriously reduced by an outbreak of sylvatic plague in Washington in 1936 (Betts 1990).

Gage and Kosoy (2005) documented several studies involving repeated plague exposure in mammals. Repeated plague exposure resulted in the appearance of at least partial resistance among some rodents. Some species, such as kangaroo rats (*Dipodymys* sp.) and Tarbagan marmots (*Marmota sibirica*) are highly resistant to plague exposure. Plague resistance varies among populations of deer mice (*Peromyscus maniculatus*) and California voles (*Microtus californicus*). However, populations of California ground squirrels (*S. beecheyi*), rock squirrels (*S. variegates*), and prairie dogs (*Cynomys* sp.) have remained highly susceptible to the plague (Gage and Kosoy 2005).

The plague may invade rapidly and have large impacts. It can lead to local extirpation of highly susceptible species (Biggins and Kosoy 2001), can reduce average densities over long time scales, or increase fluctuations in populations. Prairie dogs periodically suffer from epizootic infestation, which can lead to the rapid devastation of entire colonies (Hafner et al. 1998). The plague was introduced to North America roughly 100 years ago (Gage and Kosoy 2005), which may explain why prairie dogs have little immunity to this disease. The same may also be true for Washington ground squirrels. Due to previous documented presence of the plague in Washington ground squirrels (Svhila 1939), and its documented negative effects to closely related species (Betts 1990; Hafner et al. 1998; Biggins and Kosoy 2001; Gage and Kosoy 2005), the plague is a continuing potential threat and could be devastating to the species.

Predation appears to be a major source of mortality (Carlson et al. 1980; Betts 1990, 1999; Greene 1999; Sherman 1999, 2000). Badgers (*Taxidea taxus*) appear to be an important predator of Washington ground squirrels (Bailey 1936; Rickart and Yensen 1991; Betts 1990, 1999;

Morgan and Nugent 1999). They are a particular threat to small, isolated colonies and may cause local extirpations (Betts 1999). Morgan and Nugent (1999) noted that some colonies appeared to have been eliminated by badgers on the Boeing tract, and badger digging activity is common within Washington ground squirrel colonies (Betts 1990; Sherman 1999, 2000). On two occasions, Sherman (1999) observed badgers attempting to dig out Washington ground squirrels.

Raptors also appear to be important predators of Washington ground squirrels. In 1995, ODFW studied the impact of predation by hawks on the BNWSTF. Video monitoring of one ferruginous hawk nest (*Buteo regalis*) in 1996 showed seven of 19 prey deliveries to the nest were Washington ground squirrels (ODFW 1999). Additionally, Klein (2002, 2003, 2005) reported raptors as the most common predator of juvenile ground squirrels at her Oregon study sites. Klein (2005) found that dispersers were more vulnerable to predation by raptors while non-dispersers were move vulnerable to predation by badgers.

Other predators include the following: northern harriers (*Circus cyaneus*), golden eagles (*Aquila chrysaetos*), red-tailed hawks (*Buteo jamaicensis*), Swainson's hawks (*Buteo swainsoni*), prairie falcons, (*Falco mexicanus*), rough-legged hawks (*Buteo lagopus*), short-eared owls (*Asio flammeus*), gyrfalcons (*Falco rusticolus*), gopher snakes (*Pituophis melanoleucus)*, and western rattlesnakes (*Crotalus viridis*) (Carson et al. 1980; Greene 1999; Verts and Carraway 1998; Sherman 1999, 2000, 2005; Klein 2002, 2003). Long-tailed weasels (*Mustela frenata*) were frequently observed near colonies (Martin and Nugent 1999), and have been observed hunting and feeding on Washington ground squirrels (Sherman 1999). Coyotes (*Canis latrans*) and burrowing owls are potential predators (Carlson et al. 1980). Sherman (2005) noted that ravens (*Corvus corax*) were seen hourly during his observations, and that they may prey on juvenile ground squirrels.

The topography and vegetation at some squirrel sites likely affects the effectiveness of predation. Sherman (2005) noted that hawks often hunted perpendicularly to the long axis of coulees, likely taking prey by surprise. It is difficult for squirrels to detect aerial predators in time to seek cover, especially when hawks hunt by flying perpendicular to the axis of coulees. Similar raptor predation methods have been observed in Oregon (V. Marr, pers. comm., 2004).

D. <u>The inadequacy of existing regulatory mechanisms</u>.

Several factors related to the inadequacy of existing regulatory mechanisms affect the Washington ground squirrel in Oregon and Washington. In Washington, the species is listed as a State candidate species with no legal protection. A species is considered a candidate if sufficient evidence suggests that its status may meet the listing criteria defined for State Endangered, Threatened, or Sensitive (WDFW 1998). The State of Washington is currently developing a status review for the Washington ground squirrel. Although Washington ground squirrels receive no legal protection from the state as a candidate, they are listed as "other protected wildlife" under Washington Administrative Code (WAC) 232-12-011. This prohibits hunting, malicious killing, and possession of the animals. The protections given to "other protected wildlife" apply to all lands, including private land (G. Wiles, pers. comm. 2004).

In Oregon, the species is listed as a State endangered species due to loss of habitat, fragmentation and isolation of colonies and suitable habitat, proposed development of much of the species range within Oregon, and inadequate Federal and State regulations to protect the species (OAR 635-044-0130). The OESA provides protection from "take" (to kill or obtain possession or control of any wildlife, as defined by ORS 496.004) on State-owned, leased, or managed lands. Once listed, the OESA no longer provides any protection against take of Washington ground squirrels on private property (ORS 496.192), as was the case when the species was classified as sensitive (OAR 635-044-0130).

The State of Oregon previously owned one of the two largest contiguous blocks of land with Washington ground squirrels in the range of the species. Oregon leased the 38,708 ha (95,650 ac) property to Boeing, Inc. in the early 1960s with the stipulation that the land be developed. Boeing's development plans failed to materialize, and to meet the requirements of their lease, they subleased the property to several large agricultural corporations and individuals. The largest block of land was subleased to Inland Land. Boeing transferred the lease of the site to the Offutt Company (W. Downey, Offutt Company, pers. comm. 2000). The Offutt Company and Bos Family Oregon Farms (Threemile Canyon Farms) later purchased the property and expressed the desire to work toward an equitable management of Washington ground squirrel habitat and agricultural development.

Under the State of Oregon's survival guidelines (OAR 635-100-0136), activities detrimental to the survival of Washington ground squirrels are not to be permitted in areas of occupied habitat on State-owned, managed or leased lands. The OESA requires that survival guidelines be adopted at the time of listing (ORS 496.182; OAR 635-100-0130, 635-100-0136). Survival guidelines are "quantifiable and measurable guidelines that [the State Fish and Wildlife Commission] considers necessary to ensure the survival of individual members of the species" (ORS 496.182(2)). These survival guidelines "apply only to actions proposed on lands owned or leased by a State agency, or where a State agency holds an easement" (OAR 635-100-0136). Survival guidelines were adopted for the Washington ground squirrel on February 4, 2000 (OAR 635-100-0136).

The survival guidelines allowed continuation of planned agricultural development by exempting Inland Land from the guidelines between January 21, 2000 and February 18, 2000, providing enough time to complete planned development in 2000. The exemption was established with the provision that all "activities detrimental to the survival of Washington ground squirrels" were conducted in a manner that avoids take (i.e., killing or possessing) of Washington ground squirrels (OAR 635-100-0136).

Approximately 35 percent of the Boeing tract's 38,708 ha (95,650 ac) have been modified for irrigated agriculture (ODFW 1999). The majority of known Boeing tract sites are located on a 9,146 ha (22,600 ac) permanent ODFW Conservation Easement (BCA) and are protected under the OESA. For any other State-owned or leased land or easements elsewhere within Oregon where suitable Washington ground squirrel habitat and soil types occur, ODFW mandated State agencies consult with the Department before authorizing activities detrimental to Washington ground squirrels.

Another factor affecting the State's ability to protect the species is conflicting regulations regarding nongame species and State listed species. The take prohibition under the OESA only applies to State-owned, leased and managed lands, and is narrowly defined as “kill or obtain or control” of the species (ORS 496.004(15)). The Washington ground squirrel is also identified by the State as a protected nongame species (OAR 635-044-0130). This designation protects the species from hunting, shooting, killing, or possession on all lands within the State. However, ORS 610.105 provides an exception, allowing landowners to kill any rodent by poisoning, trapping, or other means. Because the Washington ground squirrel is a rodent, it may be vulnerable to poisoning, trapping, or other control under this statute.

Relevant Federal laws include the Endangered Species Act (Act), Clean Water Act, Fish and Wildlife Coordination Act, NEPA, and Federal Land Management and Policy Act. Federal regulations and policies provide no protection to candidate species. Although we recommend that Federal agencies confer with us to avoid economic loss and unnecessary delays if a candidate species is eventually listed and is affected by their actions, there is no requirement under the Act that Federal agencies confer with the Service for candidate species. Species that have been proposed for listing are covered by the conference procedure of section 7(a)(4) of the Act. Listing the Washington ground squirrel as an endangered or threatened species would provide protection for this species under sections 7, 9, and 10 of the Act.

E. <u>Other natural or manmade factors affecting its continued existence</u>.

As previously mentioned, many sources have document a dramatic loss and modification of historic Washington ground squirrel habitat throughout the Columbia Basin (Betts 1990, 1999; Hafner et al. 1998; ODFW 1999; Kagan et al. 2000; Wisdom et al. 2000; Knick et al. 2003; Dobkin and Sauder 2004; Quinn 2004; Tarifa and Yensen 2004). Yensen and Sherman (2003) noted that remaining populations are small, isolated, and declining due to habitat destruction and degradation. In Oregon, most known sites are on the BCA and adjacent BNWSTF. There are a few scattered, isolated sites in other portions of the state. Many sites in Washington are fragmented, and Sherman (2000) noted that the SLWMA and CNWR sites are virtually an island of shrub-steppe in a “sea of agriculture.”

Agricultural conversion of shrub-steppe habitat is the primary cause of the decline of the Washington ground squirrel, either by the complete removal or alteration of suitable habitat (Carlson et al. 1980; Betts 1990, 1999; Quade 1994; Dobler 1996). Certain types of agriculture are more destructive to squirrel habitat than others. While low to moderate grazing may not be incompatible for this species, intensive grazing has been shown to reduce cover and forage, adversely affecting Washington ground squirrels (Greene 1999). Reduced cover may make squirrels more vulnerable to predation (Vander Haegen et al. 2001), but alternatively can increase the ability to see predators. In addition to reducing cover, grazing facilitates the spread of invasive weeds, and alters vegetation structure (Knick et al. 2003). Trampling of crust (which reduces soil evaporation and prevents establishment of annual weeds) by livestock can degrade crust layers and provide seedbeds for cheatgrass and weedy forbs. Cheatgrass can out-compete native bunchgrasses and forbs that comprise Washington ground squirrel diets. While they eat cheatgrass, its nutritional value is not known and its productivity varies with annual precipitation, making it an unstable food source (Vander Haegen et al. 2001). Carlson et al. (1980) found that Washington ground squirrels commence estivation two to four weeks earlier in grazed areas, potentially indicating that green forage was in short supply. Early estivation can be harmful to Washington ground squirrels if they fail to reach an adequate weight to maintain body functions until emergence the following spring (Carlson et al. 1980).

Soil disturbance associated with crop production may be the most damaging agricultural activity to Washington ground squirrels (Carlson et al. 1980; Quade et al. 1984; Greene 1999). Tilling and other soil disturbance destroys the necessary structure of the specific silty soil-types (i.e., Warden soils) on which the species relies (Greene 1999). Surveys of areas developed for irrigated agriculture on the Boeing tract have not yielded any Washington ground squirrel observations (CH2M Hill 2000).

In addition to changes in soil composition, historic and current agricultural practices may inadvertently affect adjacent Washington ground squirrel colonies. Greene (1999) found that in addition to soil type, Washington ground squirrel density and abundance decreased with higher percentages of bare ground. Certain practices, such as leaving croplands fallow, could adversely affect foraging Washington ground squirrels. Bare ground may also leave squirrels more vulnerable to predation (Greene 1999). Furthermore, Carlson et al. (1980) described wheat fields as dispersal barriers (due to little or no vegetation coverage during years where fields are fallow). Morgan and Nugent (1999) have seen evidence of fresh dug holes extending about 40 m into an old field from a grassland colony along the field's edge. They were not sure if this was the beginning stage or re-occupancy. Interestingly, colonies still have not been established in the wheat field (Marr 2003, 2004).

Other agricultural practices may adversely affect the continued existence of Washington ground squirrels. The species has been classified as an agricultural pest since it was first identified (Bailey 1936; Howell 1938). As late as 1999, the Oregon Department of Agriculture received applications to apply pesticides to reduce Washington ground squirrel predation on crops. Other rodent species occur within and adjacent to the range of the Washington ground squirrel that are also considered agricultural and residential pests and are targeted with pesticides that could incidentally impact Washington ground squirrels. At least 27 pesticides are registered in Oregon and Washington for application targeted at ground squirrels (Washington State University (WSU) 2000). Their uses vary from home and garden to general rangeland applications (WSU 2000). Applications may also be targeted at other species that occur near Washington ground squirrel colonies (WSU 2000), but Washington ground squirrels could inadvertently be affected by runoff, overspray, or accidental ingestion. The authorized use of these pesticides is widespread in Oregon and Washington (WSU 2000) and is particularly likely to impact small and isolated colonies, but the overall affect of these chemicals on the species is unknown.

While the magnitude of conversion of Washington (and Oregon) shrub-steppe habitat to agriculture is high, its effect on wildlife is likely magnified by the pattern of land alteration resulting from the fragmentation of remaining habitat (Dobler 1996). Continued agricultural conversion further fragments suitable habitat and isolates otherwise healthy populations (Betts 1990, 1999). Quinn (2004) reported that a significant portion of high diversity shrub-steppe exists only as small fragments, often as corners of crop circles.

Isolation and fragmentation of habitat further threatens this species by increasing their vulnerability to a variety of natural and manmade factors (Quinn 2004). Isolation and fragmentation can severely affect Washington ground squirrels by limiting genetic exchange and reproduction, decreasing genetic diversity, causing genetic drift, exposing small colonies to destruction from unpredictable catastrophic events such as fire, disease, or drought, intensifying the threat of predation, and limiting habitat available for escape if occupied habitat becomes unsuitable (Betts1990; ODFW 1999; Wisdom et al. 2000). Additionally, remnant habitat is more susceptible to the surrounding landscape and external influences (Vander Haegen et al. 2001). While isolation may hinder spread of disease such as plague, it makes it unlikely that colonies would be repopulated if they did become extinct (Betts 1990).

The isolation of colonies therefore increases the risk of extinction by increasing the probability that these colonies and interactions between other colonies will be destroyed. In analyses conducted using mark and recapture techniques, Washington ground squirrels moved only short average maximum distances of 85 - 239 m (279 - 784 ft) between capture points (Carlson et al. 1980; Quade 1994; Greene 1999). Sherman (2005) documented two juvenile male dispersal movements from trap data: 1,300 m (4,265 ft) and 300 to 400 m (984 to 1,312 ft). Klein (2005) documented a 72 percent probability of dispersal for juvenile males in Oregon. Dispersal distances ranged from 40 to 3521 m (131 to 11,551 ft), with a median of 880 m (2,887 ft). Female dispersal has not been documented (Klein 2005; Sherman 2005) in Washington ground squirrels, but juvenile female dispersal has been documented in a related species, the Mohave ground squirrel (*S. movhavensis*) (Harris and Leitner 2005). Long-distance movement by juvenile and adults of both sexes may be critical for connecting local populations and recolonizing sites after local extirpation (Harris and Leitner 2005). However, the extent of habitat fragmentation precludes dispersal to many areas of historic habitat.

Another potential threat relates to the natural fluctuations of weather and potential for drought. Fluctuations in weather and climate have occurred over the species' existence throughout its range. However, the short term effects of adverse weather are now more likely to be significant when considered with other cumulative human-induced threats (ODFW 1999). Winter and spring drought events limit vegetation quality and quantity. Limited forage in spring and early summer likely affects juvenile survival to independence and survival through estivation (Carlson et al. 1980; Murie 1984; Greene 1999; ODFW 1999). Ground squirrels depend on high quality forage and abundant supply of seeds to store fat needed to survive estivation/hibernation (ODFW 1999; Vander Haegen et al. 2001). The availability of forage for diet is critical since ground squirrels commonly lose half their body weight during estivation (Carlson et al. 1980). Adequate forage quality and quantity is also needed for successful reproduction. Reynolds and Turkowski (1972) found litter size increased for Round tail ground squirrels (*S. tereticaudus*) during years with increased rainfall. Additionally, a food supplementation for Columbian ground squirrels demonstrated that density, litter size and body weight increased with food availability (Dobson and Oli 2001).

The importance of bluegrass in Washington ground squirrel diets may be a cause for concern (Tarifa and Yensen 2004). During a drought its leaves desiccate and seeds mature early, leaving squirrels with fewer food resources at the end of the growing season. This happened to Piute ground squirrels (Tarifa and Yensen 2004) and Townsend ground squirrels (Van Horne et al. 1998a, 1998b) in Idaho. Bluegrass was a major component of their diet. Early drying of bluegrass was associated with low adult and juvenile body masses prior to immergence into estivation/hibernation. This, coupled with a prolonged winter was associated with late emergence of females in 1993. Additionally, there was low overwinter ground squirrel survival in habitats where they were most dependent on bluegrass following a 1992 drought (Van Horne et al. 1998a, 1998b).

A series of drought years has reduced the occurrence of Washington ground squirrels (Quade 1994) on the BNWSTF. In contrast, Greene's (1999) study occurred after two years of above average rainfall, which led to a relatively higher abundance of the species. Densities of heteromyid rodent species are known to flux dramatically with climate change (Quade 1994). Great Basin pocket mice (*Perognathus parvus*) monitored over a 10-year period on the PGE property (on the Boeing tract) suggested a broad-scale factor, such as climate, may be partly responsible for the apparent fluctuation in rodent abundance (Quade 1994). Townsend's ground squirrels, a closely related species, showed a 50 percent population decline in response to drought conditions in 1977 (Smith and Johnson 1985; ODFW 1999). Overwinter survival rates were only 22 percent for males and 35 percent for females. Brown and Harney (1993 *in* Quade 1994) reported that Townsend's ground squirrels are known to sacrifice recruitment of offspring for adult survival during drought. Furthermore, Belding's ground squirrels are known to delay sexual maturation if body mass is low during food shortage or drought (Sherman and Runge 2002).

Klein (2003) indicated that plant growth was "observably greater and maturation was earlier in 2003 than 2002," attributable to above average rainfall recorded in December 2002, January 2003 and April 2003. Delavan (2004) also reported above average rainfall during the active season. The increased rainfall may possibly explain the recent increase of Washington ground squirrel detections on the BCA.

Another related threat is the conversion of shrub-steppe habitat to nonnative species. Little shrub-steppe habitat exists undisturbed or unaltered from condition prior to Eurasian settlement. Much of the native shrub-steppe habitat (that has not been converted to agriculture) has been converted to non-native annual grasses (particularly cheatgrass) in its understory or to completely nonnative annual grassland (Knick et al. 2003). Cheatgrass dominates most shrub-steppe ecosystems in the western United States. It occurs in large, dense, continuous patches in both inter-shrub and below-shrub spaces Cheatgrass was likely introduced to the area in the 1880s via impure grain seed (Ypsilantis 2003), and by 1920 became well established throughout shrub-steppe (O'Conner and Wieda 2001). It is now dominant plant in more than 40.5 million ha (100 million ac) in the Intermountain West (Ypsilantis 2003). It threatens squirrels by competing with native plants (important for ground squirrel diet and other needs) for water and nutrients. It can eliminate sensitive species from sites, decrease nitrogen available to perennials, and shade out biological crusts that fix nitrogen (Ypsilantis 2003).

While the effects of cheatgrass invasions on native vegetation are relatively well understood, little is known about how cheatgrass affects small vertebrates (Newbold 2005) such as the Washington ground squirrel. While Washington ground squirrels eat non-native species (including cheatgrass), eating nonnatives are not necessarily a viable long-term option (Sherman and Runge 2002; Nelson 2004). The instability of cheatgrass populations (reduced occurrence during drought) and large amounts of indigestible silica in cheatgrass may make them a poor food source, regardless of their quantity (Nelson 2004). For example, annual grasslands can support high densities of Townsend's ground squirrels, but those populations undergo wider fluctuations in size in response to climate than do populations inhabiting shrub and perennial bunchgrass communities (Marr 2001). This may also be true for Washington ground squirrels.

Altered fire regimes also threaten this species. Cheatgrass carries fire well and increases the natural fire hazard, changing fire recurrence intervals from 20 to100 years for sagebrush grassland ecosystems to three to five years for cheatgrass-dominant sites. The typical rate of fire spread, intensity, size, and frequency have also increased. Increased occurrence of fire earlier in growing season negatively affects native herbaceous species and frequent fire eliminates native shrubs, forbs, perennial grasses (Ypsilantis 2003) and allowing nonnative species to further out-compete native species (Yensen et al. 1992; Marr 2001; Vander Haegen et al. 2001). Cheatgrass recovers quickly after wildfires and can out-compete native grasses (Vander Haegen et al. 2001). Wildfires kill sagebrush, and because big sagebrush seeds are short-lived, if fire returns before new seedlings reach reproductive age (four to six years) species can be eliminated from the community. This is also true for rabbitbrush if fire intervals occur every two to four years (Vander Haegen et al. 2001). There is high potential for the occurrence of widespread fire which can attribute to the temporary loss of sagebrush. In July of 1998 lightning ignited a wildlife that consumed approximately 9,700 ha (20,000 ac) of the BNWTF. This resulted in decreased shrub cover in burned sites (Marr 2001).

Historically, fire likely played a role in maintaining Washington ground squirrel habitat (Nelson 2004). Low intensity fire may benefit squirrels by increasing available forage. In pre-settlement times, wildlife was patchy and post-burn succession generally maintained a mosaic of patches in various successional stages that would have allowed ground squirrels to take advantage of patchy new growth (Vander Haegen et al. 2001). Native bunchgrasses generally grow sparsely with forbs, bare soil, and crust between plants. This discontinuous layer burns patchy and creates a mosaic of burned verses unburned sites (Vander Haegen et al. 2001).

Another threat related to the isolation of populations is their increased susceptibility to problems associated with inbreeding (Greene 1999). Isolation of sites due to habitat destruction, modification, and curtailment may result in inbreeding and genetic drift (Holekamp 1984; Gavin et al.1999) Floyd and May (2002) completed a population genetics study of Washington ground squirrels on the SLWMA and CNWR. They examined the population structure of eight populations and identified strong genetic differentiation between sites. Approximately 11 percent of the overall genetic variation occurred between populations (versus 89 percent within). Floyd and May (2002) found 10 unique alleles, six originating from Corfu site. Severn populations were significantly differentiated at five microsatellite loci and unique alleles were present in four populations. They suggested that substantial genetic drift has arisen due to isolation of these populations.

Competition is a possible threat for this species. Carlson et al. (1980) reported that the range of periphery habitat (prior Washington ground squirrel habitat) seems to have been taken over by Columbian and Belding's ground squirrels. Both squirrels are larger and may out-compete Washington ground squirrels for available resources in a disturbed habitat. This may be the reason why there is little or no range overlap of these species. It is not clear whether they are able to or would further encroach upon Washington ground squirrel habitat in disturbed areas.

Carlson et al. (1980) reported one case of range overlap with Belding's ground squirrels near Heppner, Oregon.

Betts (1990) predicted the vulnerability to extinction of known squirrel colonies based on the size, isolation, and land use, and subsequent surveys (Betts 1999) proved many of his predictions correct. As Betts (1999) states, while small isolated populations "may persist for some time, they are highly vulnerable to extinction from a variety of factors such as predation, parasitism, and weather that may reduce the population below a sustainable level or eliminate it entirely."

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

The Threemile Canyon Farms Agreement between Threemile Canyon Farms, the Conservancy, PGE, ODFW, and the Service was signed in 2004. The Agreement includes commitments from the permittees to implement a number of conservation measures intended to benefit the Washington ground squirrel, ferruginous hawk, sage sparrow (*Amphispiza belli*), and the loggerhead shrike (*Lanius ludovicianus gambeli*) (Covered Species). If the Covered Species become listed as threatened or endangered under the Act during the 25-year Agreement period, the permits allow each permittee to take Covered Species within identified portions of the project area (Covered Area) provided that the take is incidental to implementation of Covered Activities (David Evans and Associates 2004). The Covered Area includes approximately 34,555 ha (95,000 ac) of property owned by Threemile Canyon Farms, PGE, and property leased by the Boeing Radar Range from Threemile Canyon Farms. Approximately 9,146 ha (22,600 ac) of Covered Area was placed under a permanent ODFW conservation easement (BCA) and will be managed by the Conservancy. Another 356 ha (880 ac) of property was designated by PGE Conservation Area.

The species only occurs in Oregon and Washington. The Oregon Fish and Wildlife Office (OFWO), and the La Grande Field Office (LFO) have contacted the Upper Columbia River Basin Field Office and will continue to coordinate efforts. LFO has been closely coordinating with the State of Oregon to assess the status of the species. In 1997, the Service contracted the ODFW to compile information necessary to complete this candidate assessment form. In January 1999, the State of Oregon was petitioned to emergency list the species as an endangered species under the OESA, and the species was listed as a State endangered species in January 2000. The Service has attended several meetings with the ODFW and the Oregon Fish and Wildlife Commission to obtain and analyze information and data regarding the status and potential threats to the species.

The Service is also cooperating with the State of Oregon to pursue cooperative agreements primarily with the Navy to conserve the species on the BNWSTF. However, the current amount or quality of habitat which may eventually be protected on the BNWSTF is unknown. It is also uncertain whether the level of protection offered would be adequate to provide long-term survival of the species. ODFW and LFO are pursuing a conservation agreement on the BNWSTF, managed by the Navy. To date, the Navy has been hesitant to consider a conservation agreement.

There are several recently finalized or ongoing research and monitoring efforts in Oregon and

Washington to address research needs. WDFW is monitoring historic and new sites, the Conservancy and ODFW have completed multiple-year surveys on the BCA and portions of the BNWTF, and the BLM has completed surveys on portions of their Wenatchee Resource Area. In Oregon, Klein (2005) completed a two-year juvenile dispersal study and Delavan (2004) is conducting a home range and movement study that should be completed in 2006. In Washington, Tarifa and Yensen (2003, 2004) are conducting a multiple-year diet study, Sherman (2005) is researching Washington ground squirrel demography, and WDFW is working on a draft report to examine how landscape composition affects site occupancy in Washington (R. Hill, per comm., 2005). Additionally, an upcoming study will address the population dynamics of squirrels on the SLWMA, as well as a genetic analysis of selected sites in Washington (and hopefully Oregon) (R. Hill, pers. comm. 2005). Results from research and monitoring will assist in the development and implementation of future conservation measures.

SUMMARY OF THREATS

In summary, Washington ground squirrels are primarily threatened by historic and ongoing habitat destruction and modification throughout their range. Two-thirds of their historic range has been converted to agriculture. Most of the historic habitat is permanently lost due to crop circle development, tilling, and discing. This species is currently distributed into three highly disjunct metapopulations in Oregon and Washington, separated by more than 50 km (30 mi) of unoccupied land. Isolation of existing colonies further threatens this species by increasing their vulnerability to a variety of natural and manmade factors (i.e. agriculture and wind power development, military activities, grazing, disease, predation, recreational shooting, recurrent fire, unknown but potential impacts of pesticides, spread of non-native species throughout its range, potential drought, decreased genetic diversity, genetic drift, and potential competition with other ground squirrel species in disturbed areas at the periphery of their range. Furthermore, fragmentation limits the availability for escape if occupied habitat becomes unsuitable, reduces or eliminates dispersal events, and prevents re-colonization of extirpated sites.

While there has been an increase in number of squirrel detections during this past year, this increase is likely due to increased survey effort and because this species may be at a high peak of a population cycle. There is still an overall decease in sites compared to historic locations. Furthermore, many of the detections are located in fragmented clusters. Threats are partially addressed by conservation efforts in Oregon (the Threemile Canyon Farms Agreement), ongoing research and monitoring activities, and with the OESA listing in Oregon. However, the variety of ongoing and potential threats persist throughout the entire range.

For species that are being removed from candidate status:

____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES

Washington ground squirrels may benefit from the following conservation measures:

- Maintain remaining areas of suitable habitat and restore degraded habitat using a variety of tools appropriate for site-specific needs (i.e. thinning, mechanical treatment, burning or fire suppression, reseeding and plugging of native species, etc.).

- Maintain populations as individual units where possible to prevent loss of genetic variation.
- Create or maintain corridors between occupied sites to facilitate dispersal and genetic exchange among colonies. This may be achieved using widely spaced piles of wood or stones (Sherman 2005).
- Re-establish normal fire cycles to encourage patchy (versus widespread) fire events. The appropriateness of this measure will depend on the site and methods used. Use of fire without subsequent seeding with natives may increase the amount of cheatgrass and other non-native species.
- Monitor habitat and populations in both states and survey areas of potential habitat for squirrel locations.
- Fund and carry out research in a variety of areas (i.e. monitoring effects of grazing, disease, contaminants, climate fluctuations, or translocation; studying demography, population dynamics, genetic variation, potential female dispersal, effectiveness of vegetation treatments, and potential for re-colonization of vacated sites).
- Use translocation either 1) as a last resort from areas that will be developed, 2) to augment sites experiencing inbreeding depression, or 3) to reintroduce squirrels to suitable habitat. This alternative should be used with caution, and its effects should be closely monitored to determine whether it is successful.
- Determine whether captive propagation may be appropriate.
- Post, replace, and augment signs and patrol government-owned property to increase public awareness regarding the species' status and protection where appropriate.
- Assess threats from recreational shooting. Encourage the reduction of shooting and poisoning, and enforce prohibition against shooting and poisoning where applicable.
- Increase public education about the species and threats.
- Encourage private landowners, organizations, and government land agencies to monitor and/or provide species protection.
- Explore methods to restore developed areas to native condition and monitor results.
- Combine monitoring or surveying where similar survey efforts are implemented (i.e. pygmy rabbit, sage grouse, or hawk surveys).
- Develop candidate conservation agreements for the Washington ground squirrel in both states to implement a variety of conservation measures on private and government lands.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus Species Subspecies/population	1 2 3

	Non-imminent	Monotypic genus Species Subspecies/population	4 **5*** 6
Moderate to Low	Imminent Non-imminent	Monotypic genus Species Subspecies/population Monotypic genus Species Subspecies/population	7 8 9 10 11 12

Rationale for listing priority number:

Magnitude:

Approximately two-thirds of the Washington ground squirrel's total historic range has been converted to agriculture. The effect of historic habitat destruction is magnified due to fragmentation of remaining habitat. This species is currently distributed into three highly disjunct metapopulations (which may actually be clusters of smaller, isolated populations) in Oregon and Washington, separated by more than 50 km (30 mi) of unoccupied land. Isolation of existing colonies further threatens this species by increasing their vulnerability to a variety of natural and manmade factors - i.e. agriculture and wind power development, military activities, grazing, disease, predation, recreational shooting, recurrent fire, unknown but potential impacts of pesticides, spread of non-native species throughout its range, potential drought, decreased genetic diversity, genetic isolation, genetic drift, and potential competition with other ground squirrels along the periphery of its range. Furthermore, fragmentation limits the availability for escape if occupied habitat becomes unsuitable, reduces or eliminates dispersal events, and prevents re-colonization of extirpated sites.

Magnitude of threats varies between populations. Habitat degradation, fragmentation, and increase of non-native species occur throughout the species range. Inadequate regulatory mechanisms occur in Washington and on private and Federal land in Oregon. The Threemile Canyon Farms Agreement protects roughly half of the known Oregon colonies or one-third of known habitat in Oregon from agricultural development and recreational shooting. However, this Agreement does not address threats in Washington which comprises roughly half of the species range, or on other sites within the Oregon range. Furthermore, this Agreement does not adequately address the potential effects of disease and drought on the conservation area.

While there has been an increase in number of squirrel detections during this past year, this increase is likely due to increased effort and because this species may be at a high peak of a population cycle. There is still an overall decease in sites compared to historic locations. Furthermore, many of the detections are located in fragmented clusters. Due to the variety of ongoing and potential threats throughout the entire range, this magnitude of threats for this species continues to be high.

Imminence:

As mentioned above, there are a variety of threats to the Washington ground squirrel. These include both imminent and non non-imminent threats. Imminent threats include: the persistence of invasive species (which alter natural fire regimes, available cover, and diet), proposed development of shooting ranges on the BNWTF in Oregon (but the OMD is working with ODFW to prevent take), potential genetic drift of isolated populations, and wind power development in Oregon (which occurs in shrub-steppe habitat, but typically involves compliance with ODFW).

Less-imminent threats include the continued conversion of suitable habitat to agriculture (based on trends, there are no specific documented plans for conversion), military activities (which do not currently appear to be entirely incompatible with the species), and the potential for disease, predation, and drought to impact small, isolated colonies.

The imminence of threats has recently been reduced in part because of the Threemile Canyon Farms Agreement. The Agreement addressed the imminent loss of a large portion of habitat to agriculture. Because there are no other large-scale efforts to convert suitable habitat to agriculture, and because the OMD's proposed activities and wind power projects in Oregon are complying with OESA, we maintain that threats are nonimminent.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. There are no known activities reasonably expected to occur in the near future that would put the entire species in jeopardy of extinction. While the magnitude of threats facing the species remains high, the majority of the threats are non-imminent. Recent surveys by WDFW, BLM, and the Conservancy have documented additional sites in Oregon and Washington. Furthermore, a conservation agreement was signed in 2004 that protects roughly half of known Oregon colonies (or one-third of its known occupied range) from development and recreational shooting. The effectiveness of this Agreement will be monitored closely, and efforts to increase conservation measures throughout the region will be pursued.

DESCRIPTION OF MONITORING

A variety of measures are being used in Oregon and Washington to monitor the status of the species. ODFW completed a five-year monitoring effort of the colonies on the BNWSTF in 2003. Marr (2003) revisited historic and new sites and provided some estimates for percent vacations per year. Marr also surveyed part of the north portion of the BNWSTF in 2005, locating additional sites (V. Marr, pers. comm., 2005). The entire site has not been surveyed according to the protocol established by Morgan and Nugent (1999), but 149 colonies were currently occupied as of 2003. Marr (2003) also estimated the relative size of colonies. In the future, it would be useful to complete a survey of the entire site if this becomes an option. In addition to ODFW monitoring, Klein (2002, 2003, 2005) investigated the fates and dispersal movements of juvenile males. Additionally, OFWO is funding a two-year study addressing adult movement and home range size of Washington ground squirrels on the BCA and BNWSTF

(Delavan 2004). This information will help determine the species' spatial requirements.

The Conservancy revisited all known sites on the BCA in 2004, to determine the percent vacations since 1999 and 2001. They also estimated the relative size of existing colonies including small (0 to 2,500 square m (26,610 square ft)), medium (2,500 to 10,000 square m (26,610 to 107,639 square ft)), and large (greater than 10,000 square m (107,639 square ft)). As part of their Agreement responsibilities, The Conservancy will sample available Washington ground squirrel habitat on the BCA according to the protocol established by Morgan and Nugent (1999) every two to five years to track the spatial distribution of colonies and the creation of new colonies over time. Additionally, they will sample known colonies every one to three years to document changes in their extent and activity over time (David Evans and Associates 2004). The Conservancy revisited sites in 2005, but the results are not yet available.

There are also a variety of monitoring efforts in effect for the Washington populations. BLM completed a survey in 2002 of a large portion of its Wenatchee Resource Area in Douglas and Grant Counties. They made 83 detections using a protocol similar to Morgan and Nugent (1999). WDFW is monitoring historic and new sites (including those visited by Betts) on private and government property. Preliminary results are available, but they have not distributed a final update (R. Finger, pers comm., 2004). WDFW is also working on a draft report to examine how landscape composition affects site occupancy in Washington (R. Hill, per comm., 2005).

There are additional ongoing and upcoming studies on Washington populations. One study involves a fecal analysis to better understand the dietary requirements of the species (Tarifa and Yensen 2003, 2004), and another addresses their demography and behavior (Sherman 1999, 2000, 2001, 2005). An upcoming study will address the population dynamics of squirrels on the SLWMA, as well as a genetic analysis of selected sites in Washington (R. Hill, pers. comm. 2005). This would be a useful opportunity to compare this information with the genetic makeup of selected squirrels in Oregon. The OFWO and LFO will continue to work with the Upper Columbia River Basin Field Office and the CNWR to coordinate efforts when appropriate.

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: Oregon and Washington

Indicate which State(s) did not provide any information or comments: None

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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: Acting ______________________________ 11/10/05
Regional Director, Fish and Wildlife Service — Date

Concur: ______________________________ August 23, 2006
Director, Fish and Wildlife Service — Date

Do not concur: ______________________________
Director, Fish and Wildlife Service — Date

Date of annual review:
Conducted by: